Check List the journal of biodiversity data

NOTES ON GEOGRAPHIC DISTRIBUTION

Check List 15 (3): 349–355
https://doi.org/10.15560/15.3.349

PENSOFT

Filling gaps in flower fly distributions: first record of *Aneriophora aureorufa* (Philippi, 1865) (Diptera, Syrphidae) from Argentina

Guillermo López-García[1], Rodrigo Moisés Barahona-Segovia[2,3,4], Noelia Maza[5], Martha Cecilia Domínguez[1], Ximo Mengual[6]

1 Instituto Argentino de Investigaciones de las Zonas Áridas (IADIZA-CONICET), Laboratorio de Entomología, Avenida Ruiz Leal s/n°, (5500), Mendoza, Argentina. **2** Universidad de Chile, Facultad de Ciencias Veterinarias y Pecuarias, Departamento de Ciencias Biológicas Animales, Laboratorio de Ecología de Ambientes Fragmentados, Avenida Santa Rosa 11735, La Pintana, Región Metropolitana, Chile. **3** "Moscas Florícolas de Chile" Citizen Science Program, Pasaje Arizona 4067a, Recoleta, Chile. **4** Centro de Estudios en Ecología Espacial y Medio Ambiente-Ecogeografía, Avenida José Miguel Claro 2550, Santiago, Chile. **5** Universidad Nacional de Tucumán, Facultad de Agronomía y Zootecnia, Cátedra de Zoología Agrícola, Avenida Roca 1900, (4000), Tucumán, Argentina. **6** Zoologisches Forschungsmuseum Alexander Koenig, Leibniz-Institut für Biodiversität der Tiere, Adenauerallee 160, (53113), Bonn, Germany.
Corresponding author: Guillermo Pablo López-García, guillelopezguille@gmail.com

Abstract

The genus *Aneriophora* Stuardo & Cortés 1952, previously considered endemic to Chile, is recorded for the first time from Argentina. Specimens of *Aneriophora aureorufa* (Philippi, 1865) were collected in Neuquén Province and deposited in the entomological collection of the Instituto Argentino de Zonas Áridas, Mendoza, Argentina. A diagnosis, distribution map, and photographs of *A. aureorufa* are provided.

Key words

Eristalinae, hoverflies, Neotropical Region, new record, Patagonia.

Academic editor: Tiago Kütter Krolow | Received 31 January 2019 | Accepted 18 March 2019 | Published 3 May 2019

Citation: López-García G, Barahona-Segovia RM, Maza N, Domínguez MC, Mengual X (2019) Filling gaps in flower fly distributions: first record of *Aneriophora aureorufa* (Philippi, 1865) (Diptera, Syrphidae) from Argentina. Check List 15 (3): 349–355. https://doi.org/10.15560/15.3.349

Introduction

Syrphidae is one of the most diverse and ubiquitous families in Diptera, comprising more than 200 genera and over 6,000 described species worldwide (Brown 2009, Pape and Thompson 2019). Adults of flower fly are key pollinators in crops and natural ecosystem (Ssymank et al. 2008, Lander et al. 2009, Inouye et al. 2015) and their larvae are predators, parasitoids, saprophagous, mycophagous, and phytophagous (Rotheray and MacGowan 2000, Rotheray et al. 2001, Weng and Rotheray 2008, Reemer and Rotheray 2009, Ureña and Hanson 2010, Mengual and Thompson 2011, Rotheray and Gilbert 2011, Zuijen and Nishida 2011, Pérez-Lachaud et al. 2014, Jordaens et al. 2015, Dumbardon-Martial 2016, Fleischmann et al. 2016). Due to their ecological functions, flower fly larvae are used as biological control agents of pests in greenhouses and crops (White et al. 1995, Pineda and Marcos-García 2008, Fidelis et al. 2018) and help as decomposers of organic matter (Lardé 1989, Rotheray et al. 2009, Martínez-Falcón et al. 2012). Furthermore, adults and larvae are good bioindicators of the quality of environments and ecosystems (Sommaggio 1999, Burgio and Sommaggio 2007, Sommaggio and Burgio 2014, Popov et al. 2017).

Despite the high diversity of flower flies in the

Copyright *López-García et al.* This is an open access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Neotropical region, with 60 genera and over 2,000 species (Thompson et al. 2010), studies focused exclusively on flower flies are still few and many flower flies await to be described, as well as their larval morphology and biology (Thompson et al. 1976, Thompson 1999, Amorim 2009). For Argentina, faunistic checklist and new records are sporadic and until now, 170 species belonging to 38 genera have been reported (Thompson et al. 1976, Montoya et al. 2012). The first Diptera inventory for Argentina was done by Lynch-Arribálzaga (1891–1892), followed by a catalogue of Argentine dipterans by Brèthes (1907). Much later, Fluke (1956, 1957) included the Argentine Syrphidae in his Neotropical catalogue. Thereafter, short revisions, taxonomic works, and geographic records of Argentine syrphids have been published (Shannon 1927a, 1927b, Shannon and Aubertin 1933, Blanchard 1938, Lane 1963, Lagrange 1987a, 1987b, Lagrange 1989, Lagrange 1990a, 1990b, Lagrange 1992, Kassebeer 1999, Wakeham-Dawson et al. 2009, Mengual 2011, López-García and Maza 2013, Mengual and López-García 2015, Mengual 2017). In contrast, the flower fly fauna of Chile is the most studied in South America in terms of taxonomic treatment (Blanchard 1852, Philippi 1865, Shannon 1927b, Shannon and Aubertin 1933, Stuardo-Ortiz 1946, Etcheverry 1963). Currently, 123 species and 42 genera are known (Thompson et al. 1976, Montoya et al. 2012, Barahona-Segovia pers. com.). Although they are neighbors, Argentina and Chile have a quite different fauna. Argentina and Chile share around 32.6% of the flower fly species (Thompson 1972, Thompson and Thompson 2006, Montoya et al. 2012). Then endemic genera are present only in Chile, including *Aneriophora* Stuardo & Cortés, 1952 (Thompson 1972, Thompson et al. 1976, Thompson 1999, Polidori et al. 2013, Barahona-Segovia et al. 2016).

The monotypic genus *Aneriophora* (Syrphidae, Eristalinae, Milesiini), with the species *Aneriophora aureorufa* (Philippi, 1865), is distributed between the regions of Maule and Aysén in Chile (Thompson et al. 1976, Barahona-Segovia et al. 2016, Alaniz et al. 2018). These regions represent 5 different geographical areas where *A. aureorufa* occurs: Nahuelbuta, Araucanía foothills, Valdivian coast, Los Lagos Andean foothills, and Chiloé (Barahona-Segovia et al. 2016, Alaniz et al. 2018). Adults of *A. aureorufa* are mostly found on "ulmo" *Eucryphia cordifolia* Cavanilles and "peta" *Myrceugenia planipes* (Hooker and Arnott), during the flowering season (Polidori et al. 2013, Smith-Ramírez et al. 2016). Natural distribution range for both tree species is located along the Andes Mountain Range between 45° and 37° S, at elevations up to 700 m in Chile and Argentina in the so-called Valdivian Forest and Andean Patagonian Forest (Kausel 1966, Landrum 1988, Zuloaga et al. 2008). *Aneriophora aureorufa* is associated through Batesian mimicry with the bumblebee *Bombus dahlbomii* Guérin-Méneville, 1835 (Hymenoptera, Apidae), which is endemic to Chile and Argentina and ranges from central Chile to the southern areas of these countries (Abrahamovich et al. 2004, Polidori et al. 2013). Both species are pollinators, although *A. aureorufa* is considered a specialist because it has only been found on "ulmo" and "peta" (Polidori et al. 2013, Smith-Ramírez et al. 2014, 2016, Barahona-Segovia et al. 2016). This specialization has led some authors to suggest that *A. aureorufa* can be a good bioindicator of the quality of some ecosystems where these two plant species occur (Alaniz et al. 2018). In this sense, it is important to highlight that floral resources for *A. aureorufa* have declined and will continue to decline at a rate of 1–4.5% per year in Chile, primarily due to deforestation and livestock activity (Ramos-Jiliberto et al. 2009, Barahona-Segovia et al. 2016, Alaniz et al. 2018). Consequently, *E. cordifolia* was classified as Near Threatened in Argentina in the IUCN Red List (IUCN 2019).

Here, we provide the first record of *A. aureorufa* from Argentina, together with a distribution map, photographs, and diagnosis of this species.

Methods

The examined material is deposited at the Entomological Collection of the "Instituto Argentino de Zonas Áridas" (CEI), Mendoza, Argentina. A total of 6 specimens from Argentina were studied and identified using the original description (Philippi 1865) and the publications of Thompson (1972, 1999). The morphological terminology used in diagnosis follows Thompson (1999). Argentine specimens were morphologically compared with others from Chile deposited in different institutions: Museo Nacional de Historia Natural, Santiago de Chile, Chile (MNHNCL); Museo Entomológico Luis E. Peña, Universidad de Chile, Santiago de Chile, Chile (MEUC); Museo de Zoología, Universidad de Concepción, Concepción, Chile (MZUC) and Zoologisches Forschungsmuseum Alexander Koenig (ZFMK), Bonn, Germany.

The distribution map (Fig. 1) was created with ArcGis v. 10.6.1 for records from Chile and Argentina using data from the literature, citizen science program records (CSP), specimen labels from MNHN, MEUC, MZUC, Universidad Austral de Chile, Valdivia, Chile (UACH), Instituto de Entomología de la Universidad Metropolitana de Ciencias de la Educación, Santiago de Chile, Chile (IEUMCE), Canadian National Collection of Insects, Ottawa, Canada (CNC), ZFMK, and CEI (Appendix, Table A1). The aim of the distribution map was to calculate relative distances from all points known from Chile with the new record in Argentina.

Adult photos of *A. aureorufa* were taken with a stereomicroscope Leica S6D equipped with a Leica ES3 camera. Then, digital photographs were combined using the image-stacking freeware Combine ZP v. 1.0 (Hadley 2012).

Results

New records (*n* = 1 female, 5 males). Argentina, Neuquén province, near Lácar Lake, Pucará, 40.1635° S,

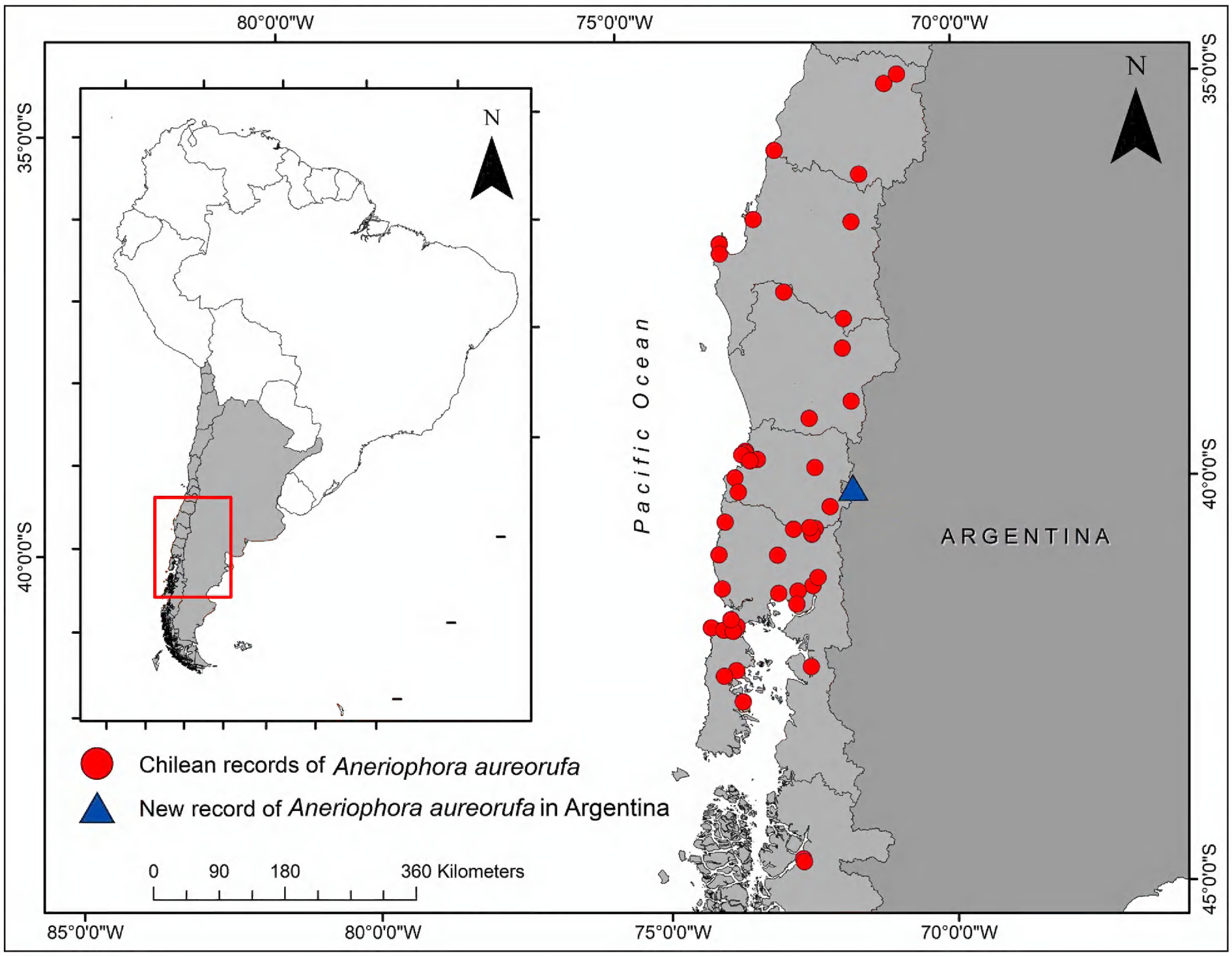


Figure 1. Distribution map of *Aneriophora aureorufa* (Philippi, 1865) in Chile and Argentina based on literature records and studied specimens.

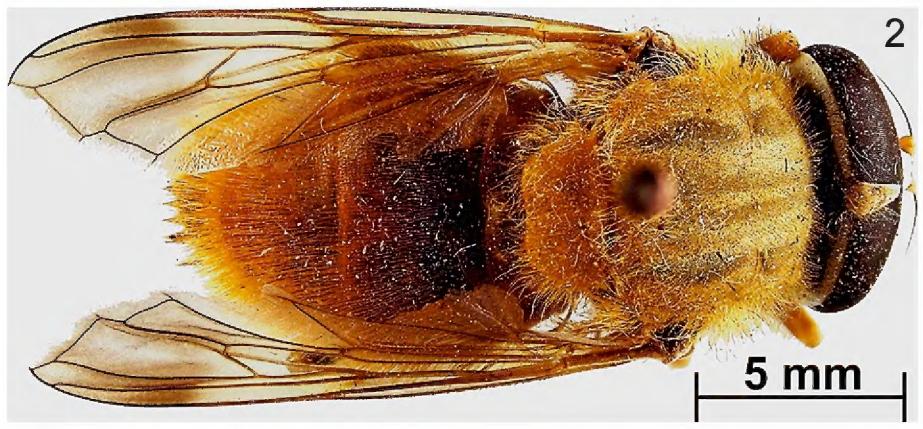
071.6326° W, altitude 630 m a.s.l., 11-III-1972, leg. Schajovskoi, 1 ♂ (CEI195312); same data, 25-I-1973, leg. Schajovskoi, 1 ♀ (CEI19509); same data, 12-II-1973, leg. Schajovskoi, 3 ♂ (CEI19508, CEI19510, CEI19512); same data, 15-III-1973, leg. Schajovskoi, 1 ♂ (CEI19513) (Fig. 1).

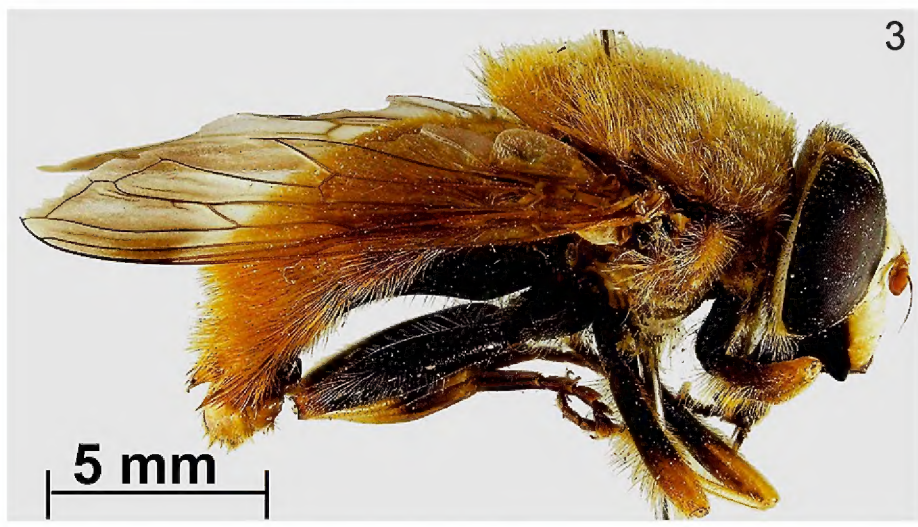
Diagnosis (adapted from Thompson 1972, 1999). *Aneriophora aureorufa* is characterized as a large fly (length 20 mm or more). Head: twice as high as long, face bare, lightly orange pilose and produced downwards. One-half of face below of bottom of eyes, slightly concave under antennae, with traces of small medial tubercle and genae shiny. Facial grooves short, extending along basal one-third of eyes and facial stripes indistinct. Frontal prominence low, on dorsal third of head. Front of male very short, as long as eye contiguity and only one-half as long as vertical triangle. Vertical triangle long, more than twice as long as broad at occiput. Front of female broad, ocellar tringle always distinctly before posterior margin of eyes. Eyes bare, holoptic in male. Antennae very short with basoflagellomere almost quadrate, arista long. Thorax: as long as broad, mostly orange pilose, with long mesonotal pile. Katepisternum with broadly separated dorsal and ventral pile patches. Anepimeron with posterior portion bare; katepimeron, meron and katatergum bare. Metasternum pilose, postmetacoxal bridge incomplete and scutellum with ventral pile fringe and apical emarginated rim. Legs: simple, except for metafemora very slightly swollen before apex in males and with only few ventral spines, metatibiae with a short, broad, rounded projection at apex. Wings: Vein M_1 and cross-vein dm-cu disjunctive, not continuous; M_2 present; cell cup with a long petiole, with petiole much longer than petiole of cell r_{4+5}. Abdomen oval, tergites orange with long orange pile and sternites shiny black with black pile (Figs 2–4).

Discussion

The present study documents the first record of *A. aureorufa* from Argentina, which has been previously considered endemic to Chile (Thompson 1972, Thompson et al. 1976, Polidori et al. 2013, Barahona-Segovia et al. 2016). This expands the geographical range of this species to the East, to the Argentine Patagonia. The locality of the new record is 145 km from the nearest Chilean southern point and 141.59 km from the nearest northern point (Fig. 1).

Based on the previous records and known biology of the species, *A. aureorufa* can be considered as native to





Figures 2–4. Specimen of *Aneriophora aureorufa* (Philippi 1865) from Argentina deposited at Entomological Collection of the Instituto Argentino de Zonas Áridas. **2.** Habitus, dorsal view. **3.** Lateral view. **4.** Specimen labels.

the Andean Patagonian and Valdivian Forests of Argentina and Chile. The geographic distribution range of *A. aureorufa* in Argentina coincides with part of geographic distribution range of *B. dahlbomii*, a bumblebee endemic to Chile and Argentina that is considered its mimetic model (Abrahamovich et al. 2004, Polidori et al. 2013). The new locality in Argentina for *A. aureorufa* is part of the so-called Valdivian Forest, where the tree species *E. cordifolia* and *M. planipes* frequently visited by this flower fly are present (Kausel 1966, Landrum 1988, Zuloaga et al. 2008, Morrone 2014). Based on the geographic distribution of *B. dahlbomii* and the tree species mentioned above, *A. aureorufa* might be present in the Argentine provinces of Neuquén, Rio Negro, Chubut, and Santa Cruz, where the distribution of "ulmo" and "peta" overlap with that of the bumblebee (Abrahamovich et al. 2004, Zuloaga et al. 2008).

Very little is known about the biology of *A. aureorufa*, its role as pollinator, or the potential impact of anthropogenic activities on this flower fly (Polidori et al. 2013, Smith-Ramirez et al. 2014, Barahona-Segovia et al. 2016). The immature stages of this flower fly species are still unknown, and we can only guess that they could play an important role in forest ecosystems as recyclers of organic matter, sharing the saprophagous habits of most of the members of the tribe Milesiini (Thompson and Rotheray 1998, Rotheray and McGowan 2000, Rotheray and Gilbert 2011, Barahona-Segovia et al. 2016).

The new finding highlights the need of further studies involving *Aneriophora* in order to better understand its role in pollination and decomposition processes in the Valdivian and Andean Patagonian forests of Argentina, as well as other ecosystem services (Rotheray and McGowan 2000, Burgio and Sommaggio 2007, Morrone 2014, Alaniz et al. 2018). Equally important is to study the activity of. *A. aureorufa* as floral visitor of *E. cordifolia*, a tree species nearly threatened in Argentina (IUCN 2019) and its potential as an environmental quality bioindicator (Sommaggio 1999, Burgio and Sommaggio 2007, Alaniz et al. 2018). Thus, studying the interactions and possible threats for *A. aureorufa* in Argentine Patagonia will give us a better knowledge on this species and habitat dynamics. Barahona-Segovia et al. (2016) calculated an historical habitat loss of 68% for this syrphid species in Chile due to agriculture, change of land use, and reforestation with exotic plants. Thus, we strongly believe that the survey of this syrphid species will help to evaluate the effects of habitat loss and fragmentation in the Argentine Patagonia, and that these new records may open new avenues for research on plant-animal interactions.

Acknowledgements

The authors are grateful to Jeff Skevington (Canadian National Collection, Agriculture and Agri-Food Canada) for sharing with us information about *A. aureorufa* specimens in CNC and Laura Pañinao for their help with the map. The authors are grateful to the reviewers. This study was supported by grant PICT 1539 from CONICET.

Authors' Contributions

GPLG, RMBS, CMD, NM, and XM prepared the manuscript. The distribution map was created by RMBS. Flower fly specimens were identified by GPLG, NM, XM, and RMBS.

References

Abrahamovich AH, Díaz NB, Morrone JJ (2004) Distributional patterns of the Neotropical and Andean species of the genus *Bombus* (Hymenoptera: Apidae). Acta Zoológica Mexicana 20 (1): 99–117.

Alaniz JA, Carvajal MA, Smith-Ramírez C, Barahona-Segovia RM, Vieli L (2018) Habitat loss of a rainforest specialist pollinator fly as an indicator of conservation status of the South American Temperate Rainforests. Journal of Insects Conservation 22: 745–755. https://doi.org/10.1007/s10841-018-0098-0

Amorim DS (2009) Neotropical Diptera diversity: richness, patterns, and perspectives. In: Pape T, Bickel D, Meier R (Eds) Diptera Diversity: Status, Challenges and Tools. Brill Press, Leiden, 71–97.

Barahona-Segovia R, Smith-Ramirez C, Alaniz A (2016) Ficha de clasificación de *Aneriophora aureorufa* Philippi, 1865. Ministerio de

Medio Ambiente. http://www.mma.gob.cl/clasificacionespecies/fichas13proceso/fichas-inicio/Aneriophora_aureorufa_INICIO_13RCE.pdf. Accessed on: 2018-5-19.

Blanchard E (1852) Orden IX Dipteros, VI Sirfianos. In: Gay C (Ed.) Historia física y política de Chile. Zoología. Museo de Historia Natural, Santiago, Vol. 7: 403–413.

Blanchard EE (1938) Descripciones y anotaciones de dípteros argentinos. Anales de la Sociedad Científica Argentina 126: 345–386.

Brèthes J (1907) Catálogo de los dípteros de las Repúblicas del Plata. Anales del Museo Nacional de Buenos Aires 16 (3): 277–305.

Brown BV (2009) Introduction. In: Brown BV, Borkent A, Cumming JM, Wood DM, Woodley NE Zumbado MA (Eds) Manual of Central American Diptera. Vol. 2. NRC Research Press, Ottawa, 1–7.

Burgio G, Sommaggio D (2007) Syrphids as landscape bioindicators in Italian agroecosystems. Agriculture, Ecosystems and Environment 120: 416–422. https://doi.org/10.1016/j.agee.2006.10.021

Dumbardon-Martial E (2016) Pollen feeding in the larva of *Toxomerus pulchellus* (Diptera, Syrphidae). Bulletin de la Société Entomologique de France 121: 413–420.

Etcheverry M (1963) Descripciones originales, sinonimia y distribución geográfica de las especies de la familia Syrphidae (Diptera) en Chile. Publicaciones del Centro de Estudios Entomológicos 5: 1–144.

Fidelis EG, do Carmo DDG, Santos AA, de Sá Farias E, da Silva RS, Picanço MC (2018) Coccinellidae, Syrphidae and *Aphidoletes* are key mortality factors for *Myzus persicae* in tropical regions: A case study on cabbage crops. Crop Protection 112: 288–294. https://doi.org/10.1016/j.cropro.2018.06.015

Fleischmann A, Rivadavia F, Gonella PM, Pérez-Bañón C, Mengual X, Rojo S (2016) Where is my food? Brazilian flower fly steals prey from carnivorous sundews in a newly discovered plant-animal interaction. Plos ONE 11 (5): e0153900. https://doi.org/10.1371/journal.pone.0153900

Fluke CL (1956) Catalogue of the family Syrphidae in the Neotropical Region. Revista Brasileira de Entomologia 6: 193–268.

Fluke CL (1957) Catalogue of the family Syrphidae in the Neotropical Region. Revista Brasileira de Entomologia 7: 1–181.

Hadley A (2012) Combine Z software. ZP. https://combinezp.software.informer.com/download/. Accessed on: 2018-5-21.

Inouye D, Larson BMH, Ssymank A, Kevan PG (2015) Flies and flowers III: ecology of foraging and pollination. Journal of Pollination Ecology 16 (16): 115–133.

IUCN (2019). The IUCN Red List of Threatened Species. Version 2018-2. https://www.iucnredlist.org/search?query=Eucryphia%20cordifolia %20&searchType=species. Accessed on: 2018-6-15.

Jordaens K, Goergen G, Kirk-Spriggs AH, Vokaer A, Backeljau T, De Mayer M (2015) A second New World hoverfly, *Toxomerus floralis* (Fabricius) (Diptera: Syrphidae), recorded from the Old World, with description of larval pollen-feeding ecology. Zootaxa 4044 (4): 567–576. https://doi.org/10.11646/zootaxa.4044.4.6

Kassebeer CF (1999) Die neotropischen Arten der Gattung *Scaeva* Fabricius, 1805 (Diptera, Syrphidae). Dipteron 2 (5): 93–108.

Kausel E (1966) Lista de las mirtáceas y leptospermáceas argentinas. Lilloa-Fundación Miguel Lillo (Tucumán-Argentina) 32: 323–368.

Lagrange EB (1987a) Notas sobre el género *Palpada* Macquart, 1834 (Diptera, Syrphidae). Neotropica 32 (87): 97–103.

Lagrange EB (1987b) Una nueva especie del género *Palpada* Macquart, 1834 (Diptera, Syrphidae). Neotropica 33 (89): 41–44.

Lagrange EB (1989) Revisión de las especies argentinas del grupo *scutellaris* del género *Palpada* Macquart, 1834 (Diptera, Syrphidae). Neotropica 35 (93): 15–34.

Lagrange EB (1990a) Las especies argentinas del género *Meromacrus* Rondani (Diptera, Syrphidae). Revista Brasileira de Entomologia 34: 489–498.

Lagrange EB (1990b) Revisión de las especies argentinas del grupo *agrorum* del género *Palpada* Macquart, 1834 (Diptera, Syrphidae). Revista de la Asociación de Ciencias Naturales del Litoral 21 (1): 3–40.

Lagrange EB (1992) Revisión de las especies argentinas del grupo Vinetorum del género *Palpada* Macquart, 1834 (Diptera, Syrphidae). Revista de la Sociedad Entomológica Argentina 50 (1–4): 145–166.

Lander TA, Harris SA, Boshier DH (2009) Flower and fruit production and insect pollination of the endangered Chilean tree, *Gomortega keule* native forest, exotic pine plantation and agricultural environment. Revista Chilena de Historia Natural 82: 403–412.

Landrum L (1988) The myrtle family (Myrtaceae) in Chile. Proceedings of the California Academy of Sciences 45: 277–317.

Lane J (1963) Insecta Patagonia (Diptera: Syrphidae). Revista de la Sociedad Entomológica Argentina 25: 17–19.

Lardé D (1989) Investigation on some factors affecting larval growth in a coffee-pulp bed. Biological Wastes 30: 11–19.

López García G, Maza N (2013) Lista de sírfidos afidófagos y primeros registros de *Pseudodoros clavatus* y *Eupeodes rojasi* (Diptera: Syrphidae), potenciales agentes de control biológico en la provincia de Mendoza, Argentina. Revista de la Sociedad Entomológica Argentina 72 (3–4): 237–240.

Lynch-Arribálzaga F (1891–1892) Dipterología Argentina, Syrphidae. Anales Sociedad Ciencia Argentina 32: 194–202, 247–256.

Martínez-Falcón AP, Marcos-García MA, Moreno CE, Rotheray GE (2012) A critical role for *Copestylum* larvae (Diptera, Syrphidae) in the decomposition of cactus forests. Journal of Arid Environments 78: 41–48. https://doi.org/10.1016/j.jaridenv.2011.10.010

Mengual X (2011) Black-tie dress code, two new species of the genus *Toxomerus* (Diptera, Syrphidae). ZooKeys 140: 1–26. http://doi.org/10.3897/zookeys.140.1930

Mengual X (2017) A new species of *Valdiviomyia* Vockeroth (Diptera: Syrphidae) from Argentina. Proceedings of the Entomological Society of Washington 119 (3): 430–441. https://doi.org/10.4289/0013-8797.119.3.430

Mengual X, López-García GP (2015) First records of *Nausigaster flukei* (Diptera: Syrphidae) from Argentina. Check List 11 (6): 1816. http://doi.org/10.15560/11.6.1816

Mengual X, Thompson CF (2011) Carmine cochineal killers: the flower fly genus *Eosalpingogaster* Hull (Diptera: Syrphidae) revised. Systematic Entomology 36: 713–731. https://doi.org/10.1111/j.1365-3113.2011.00588.x

Montoya AL, Pérez SP, Wolff M (2012) The diversity of flower flies (Diptera, Syrphidae) in Colombia and their neotropical distribution. Neotropical Entomology 41: 46–56. http://doi.org/10.1007/s13744-012-0018-z

Morrone JJ (2014) Biogeographical regionalisation of the Neotropical region. Zootaxa 3782: 1–110. http://doi.org/10.11646/zootaxa.3782.1.

Pape T, Thompson FC (2019). Systema Dipterorum (version 2.0, Jan 2011). Digital resource at www.catalogueoflife.org/col. Species 2000: Naturalis, Leiden. http://catalogueoflife.com/col/details/database/id/101. Accessed on: 2019-1-6.

Pérez-Lachaud G, Jervis MA, Reemer M, Lachaud JP (2014) An unusual, but not unexpected, evolutionary step taken by syrphid flies: the first record of true primary parasitoidism of ants by Microdontinae. Biological Journal of the Linnean Society 111 (2): 462–472. https://doi.org/10.1111/bij.12220

Philippi PI (1865) Aufzählung der chilenischen Dipteren. Verhandlunger der Zoologisch-Botanischen Gesellschaft in Wien 15: 595–782.

Pineda A, Marcos-García M (2008) Use of selected flowering plants in greenhouses to enhance aphidophagous hoverfly populations (Diptera: Syrphidae). Annales de la Société Entomologique de France 44 (4): 487–492. https://doi.org/10.1080/00379271.2008.10697584

Polidori C, Nieves-Aldrey JL, Gilbert F, Rotheray GE (2013) Hidden in taxonomy: Batesian mimicry by a syrphid fly towards a Patagonian bumblebee. Insect Conservation and Diversity 7: 32–40. https://doi.org/10.1111/icad.12028

Popov S, Miličić M, Diti I, Marko O, Sommaggio D, Markov Z,

Vujić A (2017) Phytophagous hoverflies (Diptera: Syrphidae) as indicators of changing landscapes. Community Ecology 18 (3): 287–294. https://doi.org/10.1556/168.2017.18.3.7

Ramos-Jiliberto R, Albornoz AA, Valdovinos FS, Smith-Ramírez C, Arim M, Armesto JJ, Marquet PA (2009) A network analysis of plant–pollinator interactions in temperate rain forests of Chiloé Island, Chile. Oecologia 160: 697–706. https://doi.org/10.1007/s00442-009-1344-7

Reemer M, Rotheray GE (2009) Pollen feeding larvae in the presumed predatory syrphine genus *Toxomerus* Macquart (Diptera, Syrphidae). Journal of Natural History 43 (15): 939–949. https://doi.org/10.1080/00222930802610576

Rotheray GE, Gilbert F (2011) The Natural History of Hoverflies. Forrest Text, Ceredigion, UK, 334 pp.

Rotheray GE, Hancock G, Hewitt S, Horsfield D, MacGowan I, Robertson D, Watt K (2001) The biodiversity and conservation of saproxylic Diptera in Scotland. Journal of Insect Conservation 5: 77–85. https://doi.org/10.1023/A:1011329722100

Rotheray GE, MacGowan I (2000) Status and breeding sites of three presumed endangered Scottish saproxylic syrphids (Diptera, Syrphidae). Journal of Insect Conservation 4: 215–223. https://doi.org/10.1023/A:1011380316156

Rotheray GE, Marcos-García MA, Hancock EG, Pérez-Bañón C, Maier CT (2009). Neotropical *Copestylum* (Diptera, Syrphidae) breeding in Agavaceae and Cactaceae including seven new species. Zoological Journal of Linnean Society 156: 697–749. https://doi.org/10.1111/j.1096-3642.2008.00503.x

Shannon RC (1927a) Some new Diptera from Argentina. Revista de la Sociedad Entomológica Argentina 1 (4): 31–42.

Shannon RC (1927b) A review of the South American two-winged flies of the family Syrphidae. Proceedings of the United States National Museum 70 (9): 1–34.

Shannon RC, Aubertin D (1933) Syrphidae. Diptera of Patagonia and South Chile. British Museum (Natural History). Part VI. 3: 120–170.

Smith-Ramírez C, Martínez P, Díaz I, Armesto JJ (2016) Upper canopy pollinators of *Eucryphia cordifolia*, a tree of South American temperate rain forest. Journal of Insect Biodiversity 4 (9): 1–7. http://.doi.org/10.12976/jib/2016.4.9

Smith-Ramírez C, Ramos-Jiliberto R, Valdovinos FS, Martínez P, Castillo JA, Armesto JJ (2014) Decadal trends in the pollinator assemblage of *Eucryphia cordifolia* in Chilean rainforests. Oecologia 176 (1): 157–169. https://doi.org/10.1007/s00442-014-3000-0

Sommaggio D (1999) Syrphidae can they be used as biological indicators? Agriculture, ecosystems and environment 74: 343–356. https://doi.org/10.1016/B978-0-444-50019-9.50019-4

Sommaggio D, Burgio G (2014) The use of Syrphidae as functional bioindicator to compare vineyards with different managements. Bulletin of Insectology 67 (1): 147–156.

Ssymank A, Kearns CA, Pape T, Thompson FC (2008) Pollinating Flies (Diptera): a major contribution to plant diversity and agricultural production. Biodiversity 9 (1–2): 86–89. https://doi.org/10.1080/14888386.2008.9712892

Stuardo-Ortiz C (1946) Catálogo de los Dípteros de Chile. Ministerio de Agricultura Chile, Santiago, 250 pp.

Stuardo C, Cortés R (1952) Nuevo nombre para un género de Syrphidae chileno de RA Philippi (Diptera). Revista Chilena de Entomología 2: 311.

Thompson FC (1972) A contribution to a generic revision of the Neotropical Milesinae (Diptera, Syrphidae). Arquivos de Zoologia, Sao Paulo 23: 73–215.

Thompson FC (1999) A key to the genera of the flower flies (Diptera, Syrphidae) of the Neotropical Region including descriptions of new genera and species and a glossary of taxonomic terms used. Contributions on Entomology International 3: 321–378.

Thompson FC, Rotheray GE (1998) Family Syrphidae. In: Papp L, Darvas B (Eds) Manual of Palaearctic Diptera. Vol. 3. Science Herald, Budapest, 81–139.

Thompson FC, Rotheray GE, Zumbado MA (2010) Family Syrphidae. In: Brown BV, Borkent A, Cumming JM, Wood DM, Woodley NE, Zumbado MA (Eds) Manual of Central American Diptera. Vol. 2. NRC Research Press, Ottawa, 763–792.

Thompson FC, Thompson BJ (2006) A new *Toxomerus* species from Chile (Diptera, Syrphidae). Studia Dipterologica 13: 317–331.

Thompson FC, Vockeroth JR, Sedman YS (1976) Family Syrphidae. Catalogue of the Diptera of America south of the United States. Museu de Zoologia, Universidade de São Paulo, Brasil 46: 195 pp.

Ureña O, Hanson P (2010) A fly larva (Syrphidae: *Ocyptamus*) that preys on adult flies. Revista de Biología Tropical 58: 1157–1163.

Wakeham-Dawson A, Jones AG, Thompson FC (2009) Falkland Islands Syrphidae (Diptera). Dipterists Digest 16: 65–71.

Weng JL, Rotheray GE (2008) Another non-predaceous syrphine flower fly (Diptera: Syrphidae): pollen feeding in the larva of *Allograpta micrura*. Studia Dipterologica 15: 245–258.

White AJ, Wratten SD, Berry NA, Weigmann U (1995) Habitat manipulation to enhance biological control of *Brassica* pests by hover flies (Diptera: Syrphidae). Journal of Economic Entomology 88: 1171–1176. https://doi.org/10.1093/jee/88.5.1171

Zuijen MP, Nishida K (2011) Description of life history and immature stages of phytophagous flower fly, *Allograpta zumbadoi* Thompson (Diptera: Syrphidae: Syrphinae). Studia Dipterologica 17: 37–51.

Zuloaga FO, Morrone O, Belgrano M (2008) Catálogo de las plantas vasculares del Cono Sur. Monograph in Systematic Botany 107 (1–3): 3348 pp.

Appendix

Table A1. Records of *Aneriophora aureorufa* (Philippi, 1865) used in Figure 1.

#	Localities	Country	Coordinates	Date, leg., specimen data	Source/reference
1	Valdivia	Chile	39.8139°S, 073.2458°W	1865. R.A. Philippi, holotype, 1♀, 1♂	Philippi 1865
2	Chile	Chile	35.6751°S, 071.5430°W	1926. R. Shannon, 1♀.	Shannon 1926
3	Chile	Chile	35.6751°S, 071.5430°W	1933. R. Shannon & D. Aubertin, 3♀, 4♂	Shannon & Aubertin 1933
4	Chile	Chile	35.6751°S, 071.5430°W	1949. F.M. Hull, record only	Hull 1949
5	Curacutín	Chile	38.4333°S, 071.8833°W	1963. M. Etcheverry, record only	Etcheverry 1963
6	Bío Bío	Chile	36.7728°S, 073.0630°W	1963. M. Etcheverry, record only	Etcheverry 1963
7	Llanquihue	Chile	41.2606°S, 073.0065°W	1963. M. Etcheverry, record only	Etcheverry 1963
8	Maullín	Chile	41.6167°S, 073.6000°W	1963. M. Etcheverry, record only	Etcheverry 1963
9	Chiloé	Chile	42.6767°S, 073.9934°W	1963. M. Etcheverry, record only	Etcheverry 1963
10	Aulén	Chile	41.8769°S, 072.8200°W	1963. M. Etcheverry, record only	Etcheverry 1963
11	Malleco	Chile	38.2500°S, 072.2500°W	1976. Thompson et al. 1♀, 1♂	Thompson 1976
12	Aysén	Chile	44.9166°S, 073.5833°W	1976. Thompson et al. 1♀, 1♂	Thompson 1976
13	Guabún, Lacucycuy Peninsula	Chile	41.6333°S, 074.0166°W	II.2007. obs. Smith-Ramírez et al., 8 adults	Smith-Ramirez et al. 2016

Table A1. *Continued.*

#	Localities	Country	Coordinates	Date, leg., specimen data	Source/reference
14	Estación Científica Huinay, Hornopirén	Chile	42.3666°S, 072.4094°W	20.I–24.I.2012. obs. Polidori et al., 12♀	Polidori et al. 2013
15	Polincay	Chile	41.4471°S, 072.8978°W	02.II.2016. Leg. Marcelo Maturana, 1♀	CSP
16	Estación Biológica Senda Darwin, km14	Chile	41.8865°S, 073.6731°W	17.II.2016. Leg. Barahona-Segovia, 1 adult	CSP
17	Caulin, Chacao, Chiloé	Chile	41.8279°S, 073.6086°W	17.II.2016. Leg. Barahona-Segovia, 1♀	CSP
18	Putrihuen, Castro	Chile	42.4337°S, 073.8631°W	26.II.2016. Leg. Barahona-Segovia, 1♂	CSP
19	Lago Lleu lleu, Bío bio, Arauco	Chile	38.1500°S, 073.3333°W	10. IX.2017. Leg. Sanhueza, 1 adult	CSP
20	Caulin, Chacao, Chiloé	Chile	41.8279°S, 073.6086°W	17.II.2016. Leg. Barahona-Segovia, 1♀	PCBS
21	Parque Nacional Alerce Andino	Chile	41.5905°S, 072.6062°W	13.II.2016. Leg. Barahona-Segovia, 3♂	PCBS
22	Lago Chapo	Chile	41.4308°S, 072.5808°W	18.II.2017. Leg. Barahona-Segovia, 1♂	PCBS
23	Cerros Bahía San Pedro	Chile	40.9338°S, 073.8382°W	03.II.2016. Obs. Barahona-Segovia, 1 adult	Pers. obs.
24	Rio Chaiuhín	Chile	39.9986°S, 073.5155°W	13.II.2016. Obs. Barahona-Segovia, 1 adult	Pers. obs.
25	Km 8 to Parque Oncol, Valdivia	Chile	39.6759°S, 073.3256°W	14.II.2016. Obs. Barahona-Segovia, 1 adult	Pers. obs.
26	Lago Riñihue	Chile	39.9118°S, 072.2304°W	13.II.2017. Obs. Barahona-Segovia, 1♀	Pers. obs.
27	Lago Huishe	Chile	40.4012°S, 072.0070°W	15.II.2017. Obs. Barahona-Segovia, 1 adult	Pers. obs.
28	Rio Pescado	Chile	41.3582°S, 073.8142°W	22.II.2017. Obs. Barahona-Segovia, 1♂	Pers. obs.
29	Rio Cisnes	Chile	44.7676°S, 072.6688°W	01.III.2017. Obs. Barahona-Segovia, 1 adult	Pers. obs.
30	Punta Lavapie	Chile	37.2320°S, 073.5835°W	II.1964, 1♀	UACH
31	Puerto Octay	Chile	40.9756°S, 072.8872°W	II.1968, 1♀	MZUC
32	Concepción	Chile	36.8259°S, 073.0424°W	II.1962, 1♂	MEUC
33	Fundo Los Coigües	Chile	39.3056°S, 072.2917°W	31.II.1964, 1♂	MEUC
34	Pucatrihue	Chile	40.5374°S, 073.7107°W	21.II.1967, 1♂	MEUC
35	Dalcahue, Chiloé	Chile	42.3730°S, 073.6523°W	II.1980. Leg. R. Sierpe, 1♀	MEUC
36	Parque Nacional Alerce Costero	Chile	40.1750°S, 073.4735°W	01.II.1993. Leg. Curkovic, 1♀	MEUC
37	Las Tablas, Curicó	Chile	35.1960°S, 070.9947°W	I.1993. Leg. L.E. Peña, A. Ugarte, 1♀	MEUC
38	Puerto Cisnes	Chile	44.7296°S, 072.6812°W	7.I.1967. Leg. Zapata, 1♀	IEUMCE
39	Guabun, Ancud	Chile	41.8279°S, 074.0313°W	II.1967. Leg. José Herrera, 1♀	IEUMCE
40	Termas de Rio Blanco	Chile	39.1083°S, 071.6165°W	19.II.1973. Leg. José Herrera, 8♀, 2♂	IEUMCE
41	Ralún, Llanquihue	Chile	41.3697°S, 072.3317°W	10.II.1986. Leg. Jaime Solervicens, 1♀	IEUMCE
42	Las Trancas, Chillán	Chile	36.8956°S, 071.5413°W	II.1964. Leg. Etcheverry, 2♂,1♀	MNHN
43	Parque Nacional Nahuelbuta	Chile	37.1100°S, 073.5800°W	II.1981. Leg. M. Cerda, 1♂	MNHN
44	Valdivia	Chile	39.8000°S, 073.2400°W	26.XII.1987. Leg. E. Krahmer, 2♂	MNHN
45	Osorno, Anticura	Chile	40.6500°S, 0 72.1667°W	5. III.1978. Leg. W. Mathis, 1♂	ZFMK
46	Osorno, Anticura	Chile	40.6500°S, 072.1667°W	11–12.III. 1978. Leg. W. Mathis, 1♀	ZFMK
47	Llanquihue, Cayutué	Chile	41.2333°S, 072.2666°W	13.II.1998. Leg. N.E. Woodley, 1♂	ZFMK
48	Chile	Chile	35.6751°S, 071.54296°W	13.II.1894. Leg. Bigot, 1♀	CNC
49	Osorno, Río Gol Gol	Chile	40.6500°S, 072.3500°W	10.II.1957. Leg. L. Pena, 1♀	CNC
50	Puerto Cisnes, Aysen	Chile	44.7500°S, 072.6666°W	1–15.II. 1961. Leg. L. Pena, 5♀	CNC
51	Dalcahue, Isla Chiloe	Chile	42.3776°S, 073.6518°W	1–8. II. 1962. Leg. L. Pena, 1♀	CNC
52	Curicó, Estero la Jaula	Chile	35.0830°S, 070.8000°W	I.1964. Leg. L. Pena, 1♂	CNC
53	Los Lagos, Llanquihue, Carelmapu	Chile	41.7416°S, 073.6985°W	I.1964. Leg. L. Pena, 1♀	CNC
54	Rio Blanco, Malleco	Chile	38.4333°S, 071.8833°W	II.1964. Leg. L. Pena, 1♀	CNC
55	Chiloé, Ahoni, 40 km Southeast of Castro	Chile	42.7616°S, 073.571°W	24.XII.1993. Leg. G. & M. Wood, 1 adult	CNC
56	Linares Amb. Bullileo 50 km E Parral	Chile	36.3167°S, 071.4167°W	12.I,1994. G. & M. Wood, 1♀	CNC
57	Osorno, Puyehue National Park	Chile	40.7333°S, 072.3166°W	14.I–3.II. 2017. Leg. V.C. Silva, D.S. Amorim, 1 adult	CNC
58	Los Lagos, Puyehue National Park	Chile	40.7321°S, 072.3133°W	7.II.2018. Leg. J.H., A.W., A.M. Skevington, 13 adult	CNC
59	Los Lagos, Puyehue National Park	Chile	40.7321°S, 072.3133°W	7.II.2018. Leg. J.H., A.W., A.M. Skevington, 2♀, 6 adult	CNC
60	Los Lagos, Puyehue National Park	Chile	40.7355°S, 072.3081°W	7.II.2018. Leg. J.H., A.W., A.M. Skevington, 1♀	CNC
61	Neuquén, Pucará, near Lácar Lake (new record)	Argentina	40.1635°S, 071.6326°W	11.III.1972, 25.I–12.II–15.III.1973. Leg. Schachovskoj, 1♂, 4♂, 1♀	CEI

Adult = unsexed specimen; ♀, ♂ = sexed specimen; obs = observation; pers. obs. = personal observation; record only = mention of the country only (without sex and number of specimen); CSP = citizen science program.